UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

80-29

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REPLY TO: 3430 Evaluation

March 18, 1980

SUBJECT: Fruittree Leafroller Situation on The Arrowhead RD

TO: Forest Supervisor, San Bernardino N.F.

Defoliation by the fruittree leafroller has been noticed on the San Bernardino N.F. and adjacent private lands since the mid-1970's. The infestations were rather localized and consequently the Forest Service did not perceive any impact on National Forest resources. Strong criticism of the lack of action on the part of the Forest Service by a few private land owners in 1978 prompted the FIDM Staff to examine the defoliated areas in some detail (3430, 6/6/79; 3420, 7/9/79).

On February 21, 1980, Dave Schultz, entomologist, and Gregg DeNitto, pathologist, from the FIDM Staff were on the Arrowhead RD for another Biological Evaluation and they had an opportunity to examine a few of the areas defoliated in 1978 and 1979 to determine the growth and vigor of the defoliated trees and the trend of the infestation.

Evaluation

An area which had been reported as heavily defoliated in 1978 and 1979 in Miller Canyon (T2N, R4W, S10) was examined for the presence of new and old fruittree leafroller egg masses. A count of all of the egg masses on the reachable branches of 7 oak trees resulted in a total of 67 old egg masses and 66 new egg masses. Less intensive counting on roadside trees along Route 138 between Frog Point and the Pilot Rock Camp turnoff also showed approximately equal numbers of old and new egg masses.

In the area that was reportedly heavily defoliated in 1978 and 1979, a total of 7 oak trees were sampled for growth and vigor by removing an increment core and a small root sample from each tree. Similar samples were taken from 7 oak trees in an area near the west shore of Lake Arrowhead (T2N, R3W, S16) which was reportedly not defoliated by the fruittree leafroller in 1978 or 1979. The width of each growth ring from 1965 through 1979 was measured using a microscope with an eyepiece grid. The annual average growth ring width for the defoliated and undefoliated trees as well as the October through May precipitation at Lake Arrowhead is shown on the attached graph. The root samples were sectioned and stained with an iodine-potassium iodide solution to show the amount of starch stored in the root. The stain allows the samples to be visually segregated into 4 groups; high starch reserve, medium

starch reserve, low starch reserve and depleted starch reserve. The 7 samples from the undefoliated area showed 1 tree with depleted starch reserves and 6 trees with high starch reserves. The 7 samples from the defoliated area showed 1 tree with low starch reserves, 2 trees with medium starch reserves and 4 trees with high starch reserves.

Discussion

Snow and road closures on the day of the evaluation limited the sampling for egg masses to a few areas, but there is no reason to suspect that conditions are different in the other infested areas. The finding of approximately equal numbers of old and new fruittree leafroller egg masses indicates that there will probably be about the same degree of defoliation in 1980 as seen in 1979 in the same areas (see 3420 Detection, July 9, 1979) unless there is unusual spring weather. Unusually warm spring weather could cause the eggs to hatch before the leaves expand, resulting in larval starvation. Unusually cold spring weather could also cause larval mortality, but these occurrences would be rare and impossible to predict. Larval mortality could also occur due to larval parasites or disease, but normally these biological control agents don't kill the larvae until they are nearly mature; most of the expected defoliation would have occurred by that point.

The undefoliated area where increment cores and root samples were collected was a poorer site and had more basal area than the defoliated sample area. As a consequence the average growth of trees on the undefoliated site is lower than the defoliated area. The growth trend from both areas is similar for most years from 1965 to 1977, and much of the fluctuation in growth may be explained by the amount of winter-spring precipitation. For the last two years, 1978 and 1979, the average growth of the defoliated oaks declined, but the decline was less than that seen during previous years of low precipitation. The growth rate of the undefoliated oaks increased during 1978 and 1979, but the increase was not much above that seen in previous years of abundant precipitation. Based on the average growth rates of the sample trees, mortality of oaks in the defoliated areas should not be above normal during 1980, but an additional year of defoliation could change the situation in 1981.

The results of the root staining-visible starch technique tend to confirm the conclusions drawn from the growth of the trees. The one tree in the undefoliated area that was depleted of starch reserves was an old tree that had been growing at a fairly steady rate of 0.23-0.38 mm per year for the last 15 years, and its growth pattern was different from the other trees sampled in the area. The other 6 sample trees in the undefoliated area and over half (4) of the sample trees from the defoliated area had high starch reserves. These trees would be expected to survive and make adequate to good growth during 1980, because much of a current year's growth by a tree is the result of the available starch reserves at the beginning of the growing season. The two oaks with medium starch reserves and the one with low starch reserves would be expected to survive and make some growth during 1980; an additional year of heavy defoliation might contribute to the death of the tree with low starch reserves in 1981.

The roots of dead or dying oaks may become a food base for the fungus Armillaria mellea, which is responsible for Armillaria root disease. Most of the conifer species in the defoliated areas would be susceptible to the disease. The fungus attacks the roots and root crown of trees of all ages, killing the cambium and inner bark and causing a decay of the sapwood and heartwood. In younger trees, the fungus can move rapidly to the root collar, where it girdles and kills the tree. In older, vigorous trees, the cambial advance is often checked and the fungus does not kill the host although it may persist as a decay organism. The disease spreads to living trees when the roots of an uninfected tree grow into contact with an infected root, or when a specialized fungus structure called a rhizomorph grows out of the food base to contact an uninfected root. Because of the method of spread, conifer mortality due to Armillaria root disease in the defoliated areas would be limited to a small number of seedlings and saplings growing in the immediate root zone of the dead or dying oaks.

Management Options

1. No change from current management. There will probably be 5,000-10,000 acres defoliated by the fruittree leafroller on National Forest land on the Arrowhead and San Gorgonia Ranger Districts in 1980. There will also be about 5,000-10,000 acres defoliated on adjacent or intermingled private land. Oak mortality will be about normal in the defoliated areas in 1980, but there may be an increase in mortality during 1981 and subsequent years. A small number of conifer seedlings and saplings might be killed by Armillaria root disease in mixed conifer-oak stands in 1981 and subsequent years.

2. Aerial application of chemical insecticide. The use of a chemical insecticide would kill 80-99% of the larvae in the area treated and would save much of the foliage. Aerial application is probably the only practical method of treating the entire infestation area due to limited road access, but mixed ownership patterns and domestic water supplies might make it infeasible. Treating large blocks might result in more than one year of reduced defoliation because the moths would have to fly much farther to reinfest the areas. Diazinon, malathion and carbaryl formulations appear to be registered for the fruittree leafroller. All three compounds are toxic to bees, and malathion is toxic to fish.

3. Ground application of chemical insecticide. Treatment from the ground would give far greater control over the delivery of the insecticide to those trees that could be reached, but this would result in a narrow green belt along roads and around campgrounds with defoliated areas between treated areas. The same insecticides and precautions mentioned under option 2 would also apply to ground applications. Dormant oil sprays could also be used with

ground equipment during the winter to kill the fruittree leafroller eggs, but would be inappropriate for the other life stages.

4. Aerial application of biological control agent, Bacillus thuringiensis. Bacillus thuringiensis (B.T.) is a bacterial organism which is toxic only to lepidopterous larvae. It must be eaten by the insects to become fatal to them, so the majority of the eggs must hatch before application. It has the disadvantages that the larvae do not die until a day or two after eating the material, and B.T. is inactivated by sunlight several days after application. It would eventually give control comparable to chemical insecticides, but might result in slightly more foliage lost. B.T. is non-toxic to animals, bees, fish, predators of the fruittree leafroller and is non-phytotoxic.

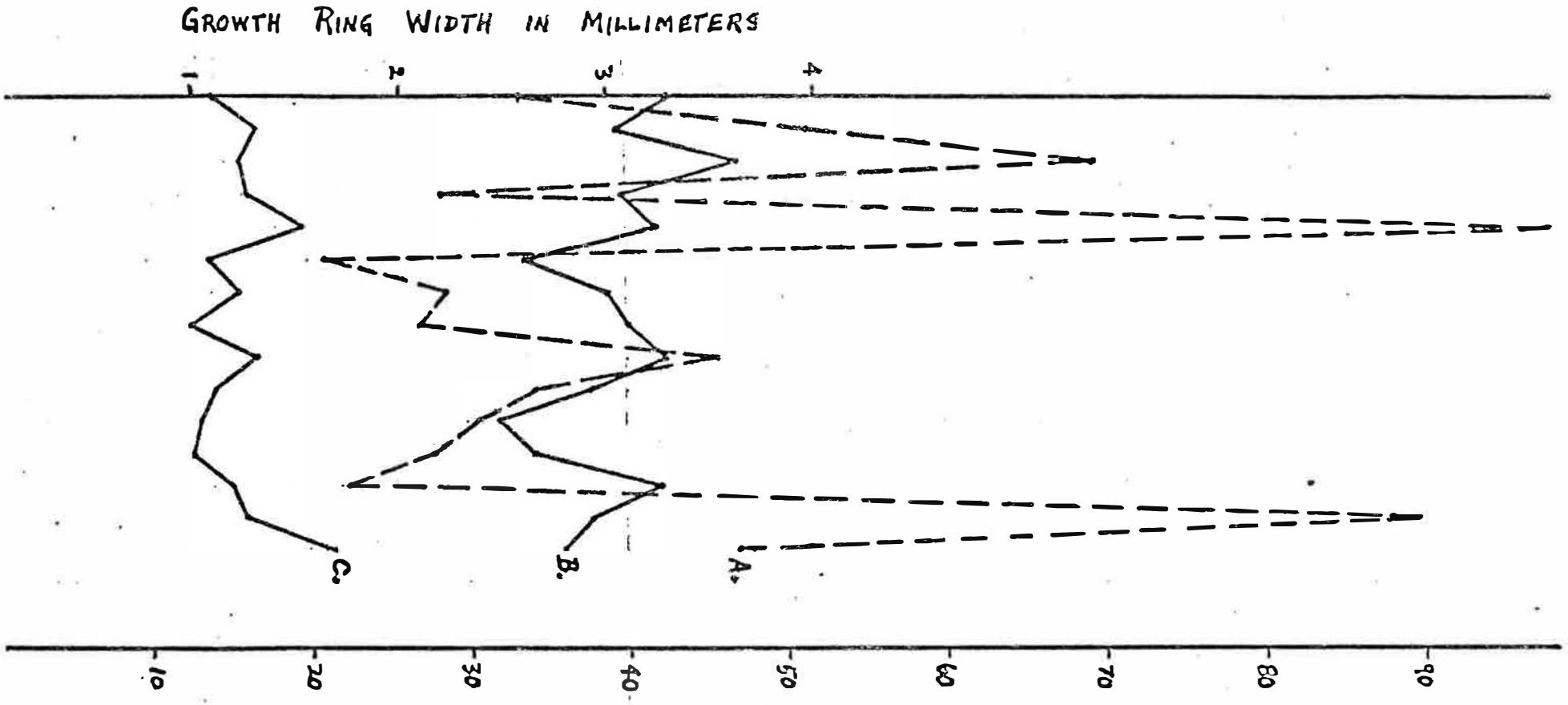
5. Ground application of Bacillus thuringiensis. Ground application of B.T. would result in the protection of foliage only in the areas treated. The disease spreads between larvae during cool, moist weather, which is unlikely to happen during the season when the larvae are present. The other characteristics of B.T. discussed under option 4 would also apply to ground applications.

Funds expended through implementation of Management Options #2-#5 could be covered by Cooperative Forestry Assistance Act monies. Requests for such funds should be made on Form FS-3400-2, Project Proposal--Forest Insect and Disease Control, supported by documentation described in FSM 3453.5, plus a Pesticide Use Request. My Staff is available to assist you in your decision making process -- including the preparation of appropriate documents.

If you need any clarification of the technical material in this evaluation, please call Dave Schultz at (415) 556-4322.

Wilfred L. Freeman Jr.

WILFRED L. FREEMAN, JR., Director
Forest Insect and Disease Management



— — A. OCTOBER-MAY PRECIPITATION AT LAKE ARROWHEAD

—— B. AVERAGE OF 7 DEFOLIATED OAKS AT MILLER CANYON

—— C. AVERAGE OF 7 NON-DEFOLIATED OAKS AT WEST SHORE LAKE ARROWHEAD